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| EXAMINER | |
|---|---|
| CHUANG, ALEXANDER | |

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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

| *Office Action Summary* | **Application No.** 10/581,345 | **Applicant(s)** SATOU ET AL. | |
|---|---|---|---|
| | **Examiner** Alexander Chuang | **Art Unit** 1795 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *10 December 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-16 and 18-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-16 and 18-19* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☒ Claim(s) *20* are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *8/6/2008*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

**SOLID OXIDE FUEL CELL WITH IMPROVED GAS EXHAUST**

***Continued Examination Under 37 CFR 1.114***

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on December 10$^{th}$ 2008 has been entered. Claim 1 has been amended. Claim 18-20 are new. The title and abstract have been amended.

2. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

***Election/Restrictions***

3. Newly submitted claim 20 is directed to an invention that is independent or distinct from the invention originally claimed for the following reasons: the subject matter of claim 20 recite "wherein the plurality the plurality of fuel gas exhaust flow channels terminate at a plurality of different points on a periphery of the associated one current collector layer which is disposed adjacent the porous fuel electrode to exhaust the consumed gas out of the periphery" is a distinct specie from "a plurality of gas exhaust flow channels formed inwardly from the surface of the associated one of the plurality of first current collector layers, wherein the plurality of gas exhaust flow channels are configured to receive consumed gas that is pushed by a fresh supply of

gas out of the blowout ports and to dissipate the consumed gas over an entire area of the surface of the associated one of the plurality of first current collector layers" as recited in claim 1.

Since applicant has received an action on the merits for the originally presented invention, this invention has been constructively elected by original presentation for prosecution on the merits. Accordingly, claim 20 withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

## *Specification*

4. The objection on the abstract has been withdrawn in view of the abstract amendment.

5. The objection on the title has been withdrawn in view of the amended title.

## *Claim Rejections - 35 USC § 103*

6. Claim 1-7, 11-13, and 18-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hara et al (WO 02/45198 A2) in view of Savage (US 2005/0016729 A1).

As to claim 1, Hara et al disclosed a solid oxide fuel cell stack comprising of:

- A plurality of electric power-generating elements (several solid oxide fuel cells) comprising of a solid electrolyte layer (figure 6, 3), and porous electrodes (page 1, lines 12-14).
- The grooves are lined with an air (figure 6, 2) and fuel electrode (figure 6, 1) layer which serves as the current collector. This layer will be referred to as a <u>current collector or interconnect</u>.

- A stress absorbing layer situated between the substrate (figure 6, 4) and solid electrolyte layer (figure 6, 3).
- In stack form, the plurality of separators is situated between current collectors. Naturally, the current collectors are situated between the electrode sections.
- The current collectors comprise a plurality of gas channels.

Hara et al does not explicitly discuss a plurality of gas supply branch flow passages branched off from one of the plurality of gas supply flow channels, the plurality of gas supply branch flow passages terminating at a plurality of blowout ports.

Savage teaches a ceramic fuel cell comprising an interconnect plate (see figure 35). This plate comprises of conduits (4999 for fuel, 1999 for oxidant) for moving the reactants through multiple passages (6666, 6060) to the ceramics (10000) and then out to the exhaust conduit or blow out ports (3999) (paragraph 142). The reference states the purpose for such a setup is to place the heated ceramics and the hot exhaust gases together (paragraph 142). This would provide a direct route for the heat to get into the fuel cell stack (paragraph 142). Thus, it would have been obvious to one of ordinary skill in the art incorporate the interconnect of Savage into Hara et al's solid oxide fuel cell, because Savage teaches this setup allows hot gas to dissipate heat over the current collector layer and into the fuel cell stack itself.

As to claim 2, Hara et al teach a fuel cell comprising of porous electrodes sandwiching a solid oxide electrolyte (figure 1, page 1, lines 12-15).

As to claim 3, Hara et al teach interconnect is situated between oxidizer electrode and the fuel electrode (in stack form). See figure 6.

As to claim 4, Hara et al. teach the gas in a solid oxide fuel cell travels through the grooves (figure 3, 42). Since the electrochemical reactions take place in the electrode, the interconnect, acting as a fluid flow plate, transfers the reactants (gas) to the electrode.

As to claim 5, the grooves are lined with an air (figure 6, 2) and fuel electrode (figure 6, 1) layer which serves as the interconnect. Since the electrode is conductive, the interconnect is lined with a porous electric conductors.

As to claim 6, the grooves (figure 3, 42) are lined with electrode material (see figure 6) and extends into the electrode.

As to claim 7, the solid oxide fuel cell comprising of two electrically conductive interconnects, one for fuel gas passage and another for oxidant fuel passage (figure 3, 42) sandwiching the electric power-generating elements (electrodes).

As to claim 11, Hara et al does not explicitly state the physical nature of the first current collector. Savage disclosed an interconnect with a plurality of conduits (figure 30, 4999, 1999) with a branch (figure 30, 6666) off the conduit and out to the exhaust (figure 30, 3999) with a ceramic (figure 30, 10000) situated on the branched section (figure 30, 6060) (paragraph 142). Therefore, it would have been obvious to one of ordinary skill in the art incorporate a branch stream off the conduit into the fuel cell of Hara et al, because Savage teaches branching of the passage allows gas distribution and allows heat transfer into the fuel cell.

As to claim 12, Hara et al does not explicitly disclose a frame section is made of metal. The ceramic (figure 30, 10000) is situated on the passage (figure 30, 6060) and serves as an enclosure to the passage, like a frame. The passage (6060) is significantly smaller than the outer fuel passages (figure 30, 6666). As known in the art, ceramics and metals conduct heat. The

placement of multiple ceramics (figure 30, 10000) allows heat distribution to be more uniform (paragraph 142). Thus, it would have been obvious to one of ordinary skill in the art to incorporate multiple ceramic pieces situated on small gas passages into the fuel cell of Hara et al, because Savage teaches this configuration allows heat distribution to be more uniform.

As to claim 13, Hara et al teaches a gas passage which goes through the fuel cell stack but does not explicitly disclose the physical properties of the openings in the outer peripheral area. Savage disclosed an interconnect as shown in figure 30. Figure 30 of Savage depicts the ceramic (figure 30, 10000) being thicker than the interconnect. Therefore, it would have been obvious to one of ordinary skill in the art to modify the dimension of the current conductor of Hara et al, because Savage teach the resultant configuration provide a more direct route of conduction into the resource formation (paragraph 142).

As to claim 18, Hara et al does not explicitly disclose sub-areas in the interconnect. Savage teaches the gas supply flow channels (figure 30, 4999 and 1999) divide the interconnect into different sections. The fuel channels (figure 20, 4999) are disposed on the outskirts of the interconnect (figure 30, 4999). A second sub-area comprises of gas exhaust channel (3999) which is distant from the first sub-area on the interconnect (figure 30). The ceramic (figure 30, 10000) is situated on the passage (figure 30, 6060) and serves as an enclosure to the passage, like a frame. The passage (6060) is significantly smaller than the outer fuel passages (figure 30, 6666). The placement of multiple ceramics (figure 30, 10000) allows heat distribution to be more uniform (paragraph 142). Thus, it would have been obvious to one of ordinary skill in the art to incorporate multiple ceramic pieces situated on small gas passages into the fuel cell of

Hara et al, because Savage teaches this configuration allows heat distribution to be more uniform.

As to claim 19, Hara et al disclose the oxidant and fuel gas channels run through the interconnect which terminates at another sub-area and blows gas out of the stack (see figure 2)

7. Claims 8-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hara et al (WO 02/45198 A2) and Savage (US 2005/0016729 A1) as applied to claim 1-7 and 11-13 above, and further in view of Minh (US 6,649,296 B1).

The teachings of Hara et al and Savage are incorporated herein.

As to claim 8, the interconnects form two salients; the first one is provided for the entering oxidant gas while the second serves as an exhaust for oxidant gas (5: 54-64). It would have been obvious to one of ordinary skill in the art to incorporate the salient into modified Hara et al, because Minh teaches the salients gather the exhaust together than expel it through the outlet (figure 1, 30).

As to claim 9-10, Minh teaches a series of oxidant channels (figure 1, 21) in the central area and a second salient (figure 1, 28) for the exhaust gas (5: 62-64). The second salient is significantly bigger than the oxidant channel in the same area - both in size and area. Thus, it would have been obvious to one of ordinary skill in the art to incorporate the salient into modified Hara et al, because Minh teaches a large area to gather up the exhaust gas and expel it through a outlet in order to remove all exhaust gas from the smaller channels in the central area.

8. Claims 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hara et al (WO 02/45198 A2) and Savage (US 2005/0016729 A1) as applied to claim 1-7 and 11-13 above, and further in view of Khandkar et al (US 5,856,035).

The teachings of Hara et al and Savage are incorporated herein.

The references do not explicitly state the nature of the third current collector. Khandkar et al discloses an interconnect comprising of felt members (figure 2a 66, figure 2b 68). Porosities of the felt members are selected that a pressure drop through the felt members are high; this prompts the fuel to flow into the flow channels (6: 44-52). Therefore, adjusting the porosity determines the pressure difference between the interconnect. Thus, porosity is a result effecting variable. Proportional balancing of a result effecting variable to achieve desired results is deemed obvious. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

9. Claims 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hara et al (WO 02/45198 A2), Savage (US 2005/0016729 A1), and Minh (US 6,649,296 B1) as applied to claim 1-7 and 11-13 above, and further in view of Khandkar et al (US 5,856,035).

The teachings of Hara et al, Savage, and Minh are incorporated herein.

The references do not explicitly state the nature of the third current collector. Khandkar et al discloses an interconnect comprising of felt members (figure 2a 66, figure 2b 68). Porosities of the felt members are selected that a pressure drop through the felt members are high; this prompts the fuel to flow into the flow channels (6: 44-52). Therefore, adjusting the porosity determines the pressure difference between the interconnect. Thus, porosity is a result

effecting variable. Proportional balancing of a result effecting variable to achieve desired results is deemed obvious. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

10. Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hara et al (WO 02/45198 A2) and Savage (US 2005/0016729 A1) as applied to claims 1-4, 11-12 above, and further in view of Barnett et al (US 5,770,327).

The teachings of Hara et al and Savage are incorporated herein.

The references do not explicitly disclose the location of reforming catalyst. Barnett et al disclosed cavities (figure 5, 21) in the interconnect. The gas flow cavities can be used for heat exchange and for placement of reforming hydrocarbon fuel gases (4: 7-11). For the reforming gases, suitable catalysts are situated in the fuel cavities (4:7-11). At the time of invention, it would have been obvious to one of ordinary skill in the art to incorporate reforming catalyst in the interconnect of modified Hara et al, because Barnett et al teaches the reforming catalyst assists in the chemical reaction of converting hydrogen containing fuel into hydrogen and feeding the hydrogen into the anode, where the electrochemical reaction takes place.

***Response to Arguments***

11. Applicant's arguments filed December 19th 2008 have been fully considered but they are not persuasive.

Applicants' principal argument is "*the passages 66662 and channels 60602 disclosed by Savage are formed in an interconnect plate, not a current collector.*"

In response to applicants' arguments, please consider the following:

It is well recognized in the art that these two terms are used interchangeably in the solid oxide fuel cell as evidenced by application publications (2002/0025458 A1 and 2002/0081475 A1). Savage disclose an interconnect with gas supply branch flow passages as shown in figure 30.

### *Conclusion*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Alexander Chuang whose telephone number is (571)270-5122. The examiner can normally be reached on Monday to Thursday 8:30 AM - 5:00 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Dah-Wei Yuan can be reached on (571)-272-1295. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

AC

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